J Orthop Sci (2010) 15:509–517
DOI 10.1007/s00776-010-1477-x

JOURNAL OF
ORTHOPAEDIC SCIENCE

Original article

Reliability, validity, and responsiveness of the Japanese version of the Patient-Rated Wrist Evaluation

Toshihiko Imaeda[1], Shigeharu Uchiyama[2], Takuro Wada[3], Shuji Okinaga[4], Takuya Sawaizumi[5], Shohei Omokawa[6], Toshimitsu Momose[7], Hisao Moritomo[8], Hiroyuki Gotani[9], Yukio Abe[10], Jun Nishida[11], and Fuminori Kanaya[12] for the Clinical Outcomes Committee of the Japanese Orthopaedic Association and the Functional Evaluation Committee of the Japanese Society for Surgery of the Hand

[1] Department of Food and Nutritional Environment, College of Human Life and Environment, Kinjo Gakuin University, 2-1723 Omori, Moriyama-ku, Nagoya 465-8521, Japan
[2] Department of Orthopaedic Surgery, Shinshu University School of Medicine, Matsumoto, Japan
[3] Department of Orthopaedic Surgery, School of Medicine, Sapporo Medical University, Sapporo, Japan
[4] Department of Orthopaedic Surgery, Tokyo Teishin Hospital, Tokyo, Japan
[5] Department of Orthopaedic Surgery, Nippon Medical School, Tokyo, Japan
[6] Department of Orthopaedic Surgery, Ishin-kai Yao General Hospital, Yao, Japan
[7] Department of Orthopaedics, Suwa Red Cross Hospital, Suwa, Japan
[8] Department of Orthopaedic Surgery, Graduate School of Medicine, Osaka University, Osaka, Japan
[9] Seikeikai Osaka Trauma and Microsurgery Center, Osaka, Japan
[10] Department of Orthopaedic Surgery, Saiseikai Shimonoseki General Hospital, Shimonoseki, Japan
[11] Department of Orthopaedic Surgery, Iwate Medical University, Morioka, Japan
[12] Orthopedic Surgery, Department of Clinical Neuroscience, Faculty of Medicine, University of the Ryukyus, Okinawa, Japan

Abstract

Background. The Patient-Rated Wrist Evaluation is a region-specific, self-administered questionnaire consisting of a pain scale (PRWE-P) and a functional scale (PRWE-F), with the latter consisting of specific function (PRWE-SF) and usual function (PRWE-UF). The PRWE was cross-culturally adapted from the original English version by the Impairment Evaluation Committee, Japanese Society for Surgery of the Hand (JSSH). The purpose of this study was to test the reliability, validity, and responsiveness of the Japanese version of PRWE (PRWE-J).

Methods. A consecutive series of 117 patients with wrist disorders completed the PRWE-J, the JSSH version of the Disabilities of the Arm, Shoulder, and Hand (DASH-JSSH) questionnaire and the 36-Item Short-Form Health Survey (SF-36). Of the 117 patients, 71 were reassessed for test–retest reliability 1 or 2 weeks later. Reliability was investigated by reproducibility and internal consistency. To analyze the validity, a factor analysis (principal axis factoring) of PRWE-J and correlation coefficients between PRWE-J and DASH-JSSH were obtained. Responsiveness was examined by calculating the standardized response mean (SRM) (mean change/SD) and effect size (mean change/SD of baseline value) after open surgery in 50 patients.

Results. Cronbach's α coefficients for PRWE-P, PRWE-F, and PRWE were 0.90, 0.95, and 0.95, respectively. The intraclass correlation coefficients (ICCs) for the same were 0.86, 0.93, and 0.92, respectively. Unidimensionality of PRWE-P was confirmed. Bidimensionality of PRWE-F was confirmed and separated clearly into PRWE-SF and PRWE-UF. The correlation coefficients between PRWE-P and PRWE-F or DASH-JSSH were 0.63 or 0.63, respectively. The correlation coefficient between PRWE-F and DASH-JSSH was 0.80. The correlation coefficients between DASH-JSSH and PRWE-SF or PRWE-UF were 0.76 or 0.73, respectively. Moderate correlation was observed in "physical functioning" for SF-36 and PRWE-SF ($r = -0.46$), PRWE-F ($r = -0.46$), or PRWE ($r = -0.46$). The SRMs/effect sizes of PRWE-P, PRWE-F, or PRWE were respectively excellent: 1.7/2.2, 1.2/1.3, 1.6/1.9.

Conclusions. The PRWE-J has evaluation capacities equivalent to those of the original PRWE.

Introduction

Health measurement scales are important patient outcome tools to measure health status and evaluate medical intervention.[1] The arthritis impact measurement scale (AIMS) was developed in 1980[2] and has been used for rheumatoid arthritis and distal radius fracture after its revision. The AIMS covers physical, social, and emotional well-being and was designed as an indicator of the outcome of care for arthritic patients. The revised version is known as AIMS2 (AIMS 2nd version).[3]

On the other hand, several measures for the evaluation of upper extremity function have been developed,[4–8] especially for patients with wrist and hand disorders. Some of them are disease-specific measures, such as the

Offprint requests to: T. Imaeda
Received: December 6, 2009 / Accepted: March 9, 2010

Brigham and Women's Carpal Tunnel Questionnaire[5] or the Carpal Tunnel Syndrome Instrument.[9,10] Others are joint-specific[4] or region-specific[6–8] measures. Especially for the wrist and hand region, the most commonly used outcome measures described in the literature[11] are the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire [6] and the Patient-Rated Wrist Evaluation questionnaire (PRWE).[7] The PRWE score is the most responsive instrument for evaluating the outcome in patients with distal radius fractures, whereas the DASH score is the best instrument for evaluating patients with disorders involving multiple joints of the upper limb.[11] The PRWE questionnaire has been used for distal radius fracture,[12] and now it is used for the trapeziometacarpal joint,[13] scaphoid nonunion,[14] proximal row carpectomy,[15] and distal radioulnar joint.[16] The PRWE is currently available in several versions, including North American French,[17] Chinese,[18] Hong-Kong,[19] German,[20] and Swedish[21] versions.

We, the Impairment Evaluation Committee of the Japanese Society for Surgery of the Hand (JSSH), have completed cross-cultural adaptation and development of the Japanese version of PRWE (PRWE-J). The purpose of this study was to test the reliability, validity, and responsiveness of the PRWE-J and to make the PRWE-J available for use in Japan.

Materials and methods

In accordance with published guidelines,[22] we organized the PRWE-J committee, which consisted of translators, researchers, and a methodologist. Our mission was to adapt the PRWE culturally into Japanese, as was done for the DASH-JSSH.[23,24]

Adaptation process

The English version of the PRWE[7] was translated into Japanese by two translators whose first language is Japanese. One of them had no medical background, and the other did. Their two "forward" translations were synthesized into one after being reviewed and discussed by the committee. This Japanese version (prefinal version) was translated back into English by two other translators whose first language is English. Both of them were blinded to the concepts being investigated and had no medical background. After we compared these two back-translations with the original PRWE, we developed the PRWE-J (prefinal version 2). Then we commenced the pilot test. After analyzing the pilot test data, we modified the prefinal version 2 of PRWE-J into a final version. The final PRWE-J version was then evaluated with regard to reliability, validity, and responsiveness.

PRWE questionnaire

The PRWE questionnaire[7] contains two subscales: a pain scale (PRWE-P) and a functional scale (PRWE-F). The PRWE-P consists of five items that have multiple-choice responses, which are scored from 1 point (mildest pain) to 10 points (most severe pain). The pain score is calculated as the sum of the scores for the five individual items.

The PRWE-F consists of a specific function scale (PRWE-SF) and a usual function scale (PRWE-UF). The answers are rated from 1 point (no difficulty with the activity) to 10 points (cannot perform the activity at all). The PRWE-SF has six specific wrist functional activities and is calculated as the total sum of all six items. The PRWE-UF has four usual wrist functional activities and is calculated as the total sum of all four items. The overall score for PRWE-F was calculated as the sum of PRWE-SF and PRWE-UF divided by two. The total PRWE score is the sum of PRWE-P and PRWE-F.

Patients and setting

The study was conducted on a consecutive series of 117 patients with a wrist or hand disorder seen on an outpatient or inpatient basis in seven orthopedic surgery departments in Japan (Table 1). Exclusion criteria were that the patients were <16 years old and/or they had wrist disorders concomitantly with a forearm disorder. The mean ± SD age was 50.0 ± 18.7 years (range 16–84 years).

The patients agreed to participate in this study. They answered the PRWE-J questionnaire, the JSSH version of the DASH (DASH-JSSH) questionnaire,[23,24] the official Japanese version of the 36-Item Short-Form Health Survey (SF-36; version 2.0),[25] and the visual analogue scale (VAS) (0–10 scale) for pain. The data collected from the 117 patients were used as a baseline value. Among the 117 patients, the 71 who had no treatment (e.g., medication or rehabilitation) during the consecutive visits were readministered the PRWE-J questionnaire 1 or 2 weeks later. Among them, 50 of the 70 patients who underwent open surgery by six hand surgeons answered the PRWE-J and the DASH-JSSH questionnaires twice: preoperatively and postoperatively 3 months after surgery.

Assessment of reliability, validity, and responsiveness

Reliability was investigated by looking at the reproducibility and internal consistency based on the test–retest method. The following analyses were conducted to examine the validity. A factor analysis (principal axis factoring) was conducted to examine the construct

Table 1. Descriptive summary of subjects

Parameter	Main morbidity (no.)	Co-morbidity (no.)
No. of subjects: 117	—	—
Sex (M/F): 48/69	—	—
Age (years), mean ± SD: 15–86 (50 ± 19)	—	—
Affected side (right/left): 62/52; both sides 3	—	—
Hand dominance[a] (right/left): 108/3	—	—
Diagnosis		—
Distal radius fracture	42	—
Ulnocarpal abutment syndrome	16	—
TFCC lesion	11	3
Kienboeck's disease	8	—
Trapezio-metacarpal osteoarthritis	5	3
Mid-carpal instability	5	—
de Quervain's disease	5	—
Scaphoid fracture	4	—
STT joint osteoarthritis	4	3
Wrist ligament lesion	4	3
Ganglion	4	—
DRUJ arthritis	3	2
Ulna styloid fracture	2	4
Others	4	4
Total	117	22

TFCC, triangular fibrocartilage complex; STT, scaphotrapezotrapezoidal; DRUJ, distal radioulnar joint
[a] Six patients had no record of hand dominance

validity and the unidimensionality of the PRWE-P and PRWE-F. Completeness of item responses of the PRWE-J was examined.

Correlation coefficients between the PRWE-P and PRWE-F and the DASH-JSSH were obtained. The following hypotheses were examined to investigate concurrent validity: (1) the PRWE-P would exhibit moderate association with DASH-JSSH; (2) the PRWE-F (SF and UF) would exhibit the strongest association with DASH-JSSH.

Correlation coefficients between the PRWE-P and PRWE-F and the SF-36 were also obtained. The following hypotheses were examined to investigate concurrent validity: (1) the PRWE-P would exhibit the strongest association with "bodily pain" (SF-36-BP) among SF-36 subscales; (2) the PRWE-F (SF and UF) would exhibit the strongest association with "physical functioning" (SF-36-PF) or "role-physical" (SF-36-RP). Those three subscales of SF-36 were chosen because the correlation between the DASH-JSSH and the three subscales of SF-36 was more than moderate.[7]

The responsiveness of both the PRWE-J and DASH-JSSH were examined by calculating the standardized response mean (SRM) (mean change/SD)[26] and effect size (mean change/SD of baseline value)[27] after open surgery.

The protocol of this study was reviewed and approved by the institutional review board of Nippon Medical School prior to implementation.

Statistical analysis

Distribution of the PRWE-J, DASH-JSSH, SF-36, and VAS for pain, ages of the subjects, and time required to fill out the PRWE-J questionnaire were assessed. The interval measurements (PRWE-J, DASH-JSSH, all subscales of SF-36 except physical functioning and age) were normally distributed; the other interval measurements (physical functioning of SF-36, VAS for pain, and time required to fill out the PRWE-J questionnaire) were not normally distributed. Then, Cronbach's α was used to assess the internal consistency of PRWE-J (P and F). The instrument test–retest reliability of PRWE-J (P and F) was assessed with the intraclass correlation coefficient (ICC). All correlation coefficients among the PRWE-J (P and F), DASH-JSSH, and SF-36 were calculated with use of Spearman's correlation (nonparametric test) because some subscales of SF-36 were not normally distributed. Changes in measurement after carpal tunnel release were assessed with a parametric test (paired *t*-test). All statistical analyses were conducted using the Statistical Package for Social Science

(SPSS) version 17.0.J software. The critical values for significance were set at $P < 0.05$.

Results

Completeness of item responses

No patients had difficulty completing the PRWE-J questionnaire. It took them 3 min 39 s, on average, to finish it (median 3 min 12 s; range 1–10 min). Most of the patients considered all the items to be clear. Of the 117 patients, 4 did not answer one or more items. Among the four patients, one failed to answer four items and another failed to answer two items. Each of the other two patients failed to answer one item. The items that they failed to respond to were as follows: Item 4 of PRWE-P was left unanswered by two patients, items 4 and 5 of PRWE-SF were each unanswered by one patient, item 3 of PRWE-UF was left unanswered by one patient, and item 4 of PRWE-UF was unanswered by three patients.

The mean, median, standard deviation, and range of the PRWE-J, DASH-JSSH, SF-36, and VAS for pain are shown in Table 2. Two, eight, and two patients had the minimum disability score of zero (ceiling) on the PRWE-SF, PRWE-UF, and PRWE-F, respectively. A total of 5, 26, 6, and 6 patients had a maximum disability score (floor) on the PRWE-P, PRWE-SF, PRWE-UF, and PRWE-F, respectively. No patients had a minimum or maximum disability score on the PRWE.

Reliability

Internal consistency was assessed by use of Cronbach's α coefficient (Table 3). The α coefficient for the five

Table 2. Scores for PRWE, DASH, SF-36, and VAS

Instrumental scale	No.	Mean	SD	Median	Minimum	Maximum
PRWE-P	114	30.5	11.5	32	1	50[b]
PRWE-SF	115	36.0	20.7	40	0[a]	60[b]
PRWE-UF	112	20.6	12.1	22	0[a]	40[b]
PRWE-F	112	28.2	15.4	29.5	0[a]	50[b]
PRWE	112	58.7	24.3	61.5	5	99
DASH-JSSH	116	44.2	28.2	39.5	0[a]	100[b]
SF36-PF_N	111	37.9	18.4	44.6	−11.8	58.7
SF36-RP_N	114	30.0	16.7	29.0	1.7	56.2
SF36-BP_N	114	36.7	10.5	35.3	17.2	61.4
SF36-GH_N	113	49.1	9.0	48.9	28.9	69.4
SF36-VT_N	113	47.4	10.0	47.2	19.5	68.7
SF36-SF_N	114	43.0	13.9	43.9	4.5	57.1
SF36-RE_N	114	37.0	16.7	39.6	5.6	56.6
SF36-MH_N	112	44.4	11.1	43.8	14.6	65.1
VAS	111	59.3	24.3	60	6	100[b]

PRWE-P, pain scale of the Japanese version of the Patient-Rated Wrist Evaluation (PRWE-J); SF, Specific Functional scale; UF, Usual Functional scale; F, Functional Scale
DASH-JSSH, Disability/Symptom scale of the Japanese version of the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire
SF-36-PF_N, Standardized Physical Functioning subscale of the 36-Item Short-Form Health Survey (SF-36); RP_N, Standardized Role–physical subscale; BP_N, Standardized Bodily Pain subscale; GH_N, Standardized General Health subscale; VT_N, Standardized Vitality subscale; SF_N, Standardized Social Functioning subscale; RE_N, Standardized Role–emotional subscale; MH_N, Standardized Mental Health subscale
VAS, visual analogue scale for pain (0–10 scale)
[a] Maximum health status scores (ceiling)
[b] Minimum health status scores (floor)

Table 3. Internal consistency

Instrument scale	No.	Cronbach's α	Cronbach's α range
PRWE-P	114	0.90	0.86–0.91
PRWE-SF	115	0.96	0.94–0.96
PRWE-UF	112	0.92	0.87–0.91
PRWE-F	111	0.95	0.94–0.95
PRWE	110	0.95	0.95–0.95

Table 4. Intraclass correlation coefficient of PRWE

Instrument scale	No.	ICC	95% CI
PRWE-P	69	0.86	0.77–0.91
PRWE-SF	69	0.90	0.84–0.94
PRWE-UF	67	0.94	0.90–0.96
PRWE-F	67	0.93	0.88–0.96
PRWE	67	0.92	0.88–0.95

ICC, intraclass correlation coefficient; CI, confidence interval

items in the PRWE-P was 0.90 (n = 114); and when calculated for each of the five items by eliminating each item one by one, the range was 0.86–0.91. The α coefficient for the six items in the PRWE-SF was 0.96 (n = 115); and after eliminating one by one, the range was 0.94–0.96. The α coefficient for the four items in the PRWE-UF was 0.92 (n = 112); and after eliminating one by one, the range was 0.87–0.91. The α coefficient for the 10 items in the PRWE-F was 0.95 (n = 111); and after elimination one by one, the range was 0.94–0.95. The α coefficient for the 10 items in the PRWE was 0.95 (n = 110); and after eliminating one by one, the range was 0.95–0.95. In all of the above, no items were found to change the internal consistency substantially.

Instrument test–retest reliability was assessed with the intraclass correlation coefficient (ICC) (Table 4). There were 69 of 71 patients for the test–retest reliability who had no missing items, and the period between the first and second tests was a mean of 8.0 ± 3.5 days (range 1–18 days). The ICCs for the PRWE-P, PRWE-F, and PRWE were 0.86 [95% confidence interval (CI) 0.77–0.91], 0.93 (95% CI 0.88–0.96), and 0.92 (95% CI 0.88–0.95), respectively. All ICCs for the PRWE-J subscales and total scale indicate sufficient reproducibility.

Validity

A factor analysis (principal axis factoring) was conducted to confirm the unidimensionality of the PRWE-P and PRWE-F. The first factor of the PRWE-P had an eigenvalue (amount of variation in the total sample accounted for by that factor) [24] of 3.60, which explained the 72% total variance of the PRWE-P scores (Fig. 1). The unidimensionality of the PRWE-P was found to be strong as a result of the low eigenvalue of the second factor (0.55) (Fig. 1). When looking at the first factor loading for each item, all items had loading of 0.4 or higher (Table 5).

The first factor of the PRWE-F had an eigenvalue of 7.06, which explained the 71% total variance of the PRWE-F scores (Fig. 2). The second factor of the PRWE-F had an eigenvalue of 1.16, which explained the 12% total variance of the PRWE-F scores and resulted in explaining 82% cumulative of PRWE-F scores (Fig. 2). The third factor of the PRWE-F had an

Table 5. Component matrix of factor analysis for PRWE-P

Item	Component
Pain-1	0.73
Pain-2	0.91
Pain-3	0.87
Pain-4	0.87
Pain-5	0.84

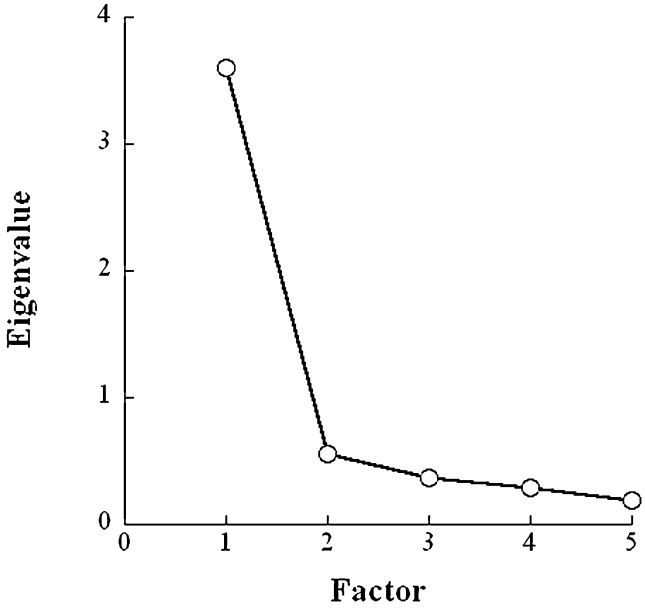

Fig. 1. Scree plot of the Patient-Rated Wrist Evaluation, Pain Scale (PRWE-P) factors

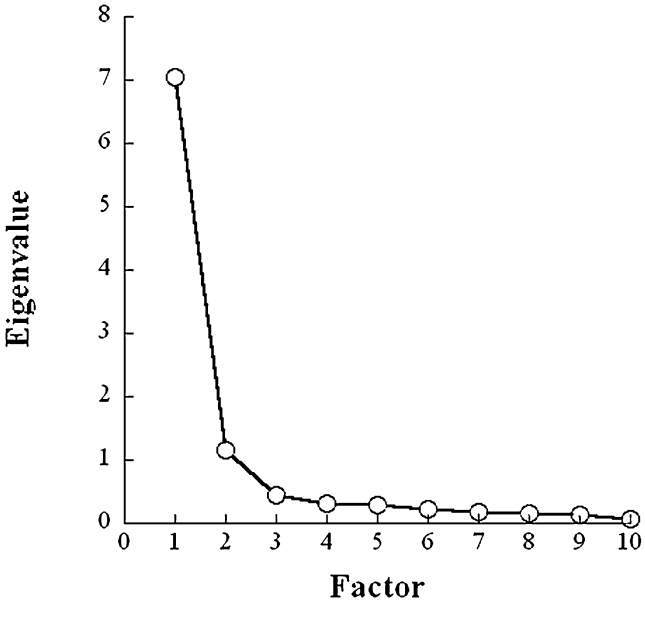

Fig. 2. Scree plot of the PRWE-F (where F represents the Functional Scale) factors

eigenvalue of 0.44, which explained the 4% total variance of the PRWE-F scores. A factor analysis indicates two factors in the PRWE-F, which means the PRWE-F demonstrated a bidimensional structure.

When looking at the first factor loading for each item, all items had loading of 0.4 or higher (Table 6). In addition, when looking at the second factor loading for each item, all items of specific function had minus values and all items of usual function had plus values (Table 6). This indicates that PRWE-F is composed of two types of item: specific function and usual function.

The correlation coefficients between the PRWE-P and the PRWE-F or the DASH-JSSH were 0.64 and 0.63, respectively (Table 7) ($P < 0.01$). These results indicate moderate correlations between the PRWE-P and the PRWE-F and between the PRWE-P and the DASH-JSSH. The correlation coefficient between the PRWE-F and DASH-JSSH was 0.80 (Table 7) ($P < 0.01$), which indicates a strong correlation between them. The correlation coefficients between the DASH-JSSH and PRWE-SF or the PRWE-UF were 0.76 and 0.73, respectively (Table 7) ($P < 0.01$). These results demonstrate strong correlations between the PRWE-SF and the DASH-JSSH as well as between the PRWE-UF and the DASH-JSSH and support the hypotheses set down in advance (Table 7).

The correlations between the PRWE-P score and the subscales of the SF-36 scale ranged from –0.24 to –0.37 (Table 7). The strongest correlation was observed in "bodily pain." The correlations between the PRWE-P and "bodily pain," "role-physical," and "physical functioning" were somewhat weak. These results do not support the hypotheses set down in advance.

The correlations between the PRWE-SF score and the subscales of the SF-36 scale ranged from –0.16 to –0.46 (Table 7). A moderate correlation was observed in "physical functioning" and the PRWE-SF ($r = –0.46$), PRWE-F ($r = –0.46$) or PRWE ($r = –0.46$). These results support the hypotheses set down in advance (Table 7). The correlations between the PRWE-SF and "bodily pain" or "role-physical" in SF-36 were somewhat weak. These results do not support the hypotheses set down in advance.

The correlations between the PRWE-UF score and the subscales of the SF-36 scale ranged from –0.26 to –0.41 (Table 7). A moderate correlation was observed in the PRWE-UF and "physical functioning," "bodily pain," and "role-physical" ($r = –0.37$, –0.40, and –0.40, respectively.). These results support the hypotheses set down in advance.

The correlation between the PRWE-P score and VAS for pain was moderate ($r = 0.66$), and the correlation between PRWE-F score and VAS for pain was moderate ($r = 0.64$) (Table 7).

Table 6. Component matrix of factor analysis for PRWE-F

	Component	
Item	1	2
SF-1	0.90	–0.22
SF-2	0.91	–0.21
SF-3	0.88	–0.17
SF-4	0.83	–0.34
SF-5	0.82	–0.29
SF-6	0.89	–0.28
UF-1	0.84	0.35
UF-2	0.82	0.45
UF-3	0.72	0.55
UF-4	0.80	0.33

SF, Specific Functional scale of PRWE-J; UF, Usual Functional scale of PRWE-J

Table 7. Correlation of PRWE, DASH, SF-36, and VAS

		Spearman's correlation					
Instrument scale	No.	PRWE-P	PRWE-SF	PRWE-UF	PRWE-F	PRWE	DASH
PRWE-P	114						
PRWE-SF	113	0.59**					
PRWE-UF	110	0.61**	0.76**				
PRWE-F	110	0.64**	0.96**	0.91**			
PRWE	110	0.78**	0.92**	0.89**	0.97**		
DASH	113	0.63**	0.76**	0.73**	0.80**	0.81**	
SF36-PF_N	112	–0.35**	–0.46**	–0.37**	–0.46**	–0.46**	–0.59**
SF36-RP_N	112	–0.28**	–0.35**	–0.40**	–0.38**	–0.36**	–0.52**
SF36-BP_N	111	–0.37**	–0.33**	–0.40**	–0.36**	–0.37**	–0.43**
SF36-GH_N	111	–0.35**	–0.16	–0.26**	–0.21*	–0.26**	–0.20*
SF36-VT_N	112	–0.32**	–0.35**	–0.35**	–0.39**	–0.39**	–0.46**
SF36-SF_N	112	–0.30**	–0.38**	–0.41**	–0.44**	–0.42**	–0.56**
SF36-RE_N	110	–0.26**	–0.34**	–0.41**	–0.38**	–0.36**	–0.50**
SF36-MH_N	109	–0.24*	–0.36**	–0.34**	–0.39**	–0.36**	–0.46**
VAS	114	0.66**	0.61**	0.61**	0.64**	0.70**	0.56**

*$P < 0.05$; **$P < 0.01$

A multiple regression analysis of PRWE adjusted by age and sex was conducted because a statistical difference ($P = 0.002$) in age was found between means ± SD for men (43 ± 18 years) and women (54 ± 18 years). The PRWE scores were explained by the DASH score and VAS for pain (Table 8).

Responsiveness

Among the 70 patients who underwent open surgery, 50 completed the PRWE and the DASH-JSSH at 3 months (mean ± SD 105 ± 25 days) after the surgery. The mean age of the subjects was 62 ± 14 years (range 21–86 years). There were 20 men and 30 women. The calculated SRMs and effect sizes of PRWE-P, PRWE-SF, PRWE-UF, PRWE ($n = 50$), and DASH-JSSH ($n = 50$) were 1.73/2.18, 1.13/1.29, 1.13/1.19, 1.55/1.92, and 1.30/1.20, respectively (Table 9). There were statistically significant differences between the mean value of preoperative and postoperative PRWE-P, PRWE-SF, PRWE-UF, PRWE and DASH-JSSH ($n = 50$).

Among those subjected to the surgery, 24 of 50 had distal radius fractures. The calculated SRMs and effect sizes of PRWE-P, PRWE-SF, PRWE-UF, PRWE, and DASH-JSSH were 1.81/2.05, 1.59/6.20, 1.50/1.75, 1.90/3.32, and 2.13/2.05, respectively (Table 9). There

Table 8. Multiple regression of PRWE

					95% CI of B	
Parameter	B	SE B	β	*P*	Lower	Upper
Constant	29.71	12.02		0.02	5.81	53.62
Age	0.05	0.09	0.04	0.58	–0.13	0.23
Sex	–1.40	3.00	–0.03	0.64	–7.37	4.56
DASH	0.54	0.07	0.65	0	0.39	0.68
SF36-PF_N	0.02	0.10	0.02	0.81	–0.18	0.23
SF36-RP_N	0.11	0.15	0.08	0.49	–0.20	0.41
SF36-BP_N	–0.21	0.19	–0.09	0.26	–0.59	0.16
SF36-GH_N	–0.27	0.18	–0.11	0.13	–0.62	0.08
SF36-VT_N	–0.13	0.26	–0.05	0.62	–0.64	0.38
SF36-SF_N	0.14	0.15	0.08	0.38	–0.17	0.44
SF36-RE_N	0.13	0.17	0.09	0.44	–0.20	0.46
SF36-MH_N	–0.07	0.23	–0.03	0.76	–0.54	0.39
VAS	0.36	0.07	0.35	0	0.22	0.50

$R^2 = 0.74$ ($n = 99$)
B, unstandardized coefficient; SE B, standard error of B

Table 9. Standardized response means and effect size of PRWE and DASH

	Total			Radius fracture		
Instrument scale	No.	SRM	Effect size	No.	SRM	Effect size
PRWE-P	50***	1.73	2.18	24***	1.81	2.05
PRWE-SF	50***	1.13	1.29	24***	1.59	6.20
PRWE-UF	50***	1.13	1.19	24***	1.50	1.75
PRWE-F	50***	1.20	1.32	24***	1.77	3.63
PRWE	50***	1.55	1.92	24***	1.90	3.32
DASH	50***	1.30	1.20	24***	2.13	2.05
SF36-PF_N	48***	–0.56	–0.54	24***	–0.80	–0.85
SF36-RP_N	49***	–0.67	–0.62	24***	–0.73	–0.71
SF36-BP_N	49***	–0.79	–0.95	24**	–0.61	–0.67
SF36-GH_N	48	–0.16	–0.17	24	–0.43	–0.39
SF36-VT_N	49**	–0.41	–0.50	24**	–0.68	–0.94
SF36-SF_N	49***	–0.66	–0.72	24***	–1.04	–1.11
SF36-RE_N	49***	–0.75	–0.65	24***	–0.91	–0.77
SF36-MH_N	48***	–0.67	–0.69	24***	–0.75	–0.98
VAS	49***	1.75	2.23	24***	2.00	2.96

SRM, standardized response means
* Significant difference between the preoperative and postoperative median values ($P < 0.05$)
** Significant difference between the preoperative and postoperative median values ($P < 0.01$)
*** Significant difference between the preoperative and postoperative median values ($P < 0.001$)

were statistical differences between the mean values of preoperative and postoperative PRWE-P, PRWE-SF, PRWE-UF, PRWE, and DASH-JSSH ($n = 24$).

Discussion

The original PRWE questionnaire was cross-culturally adapted into Japanese in accordance with a systematic standardized approach.[23] The purpose of this study was to examine the psychometric qualities of the PRWE-J by assessing its psychometric standards in the areas of reliability, validity, and responsiveness.

The PRWE consists of a 5-item pain scale and a 10-item functional scale. It took patients a shorter amount of time to complete the PRWE-J than to complete the DASH-JSSH.[24] The amount of time to complete the PRWE-J was equivalent to the time to complete the North American French version of PRWE (3 min, range 5–7 min).[17] This indicated that the questionnaire was easy to understand. Whereas the DASH-JSSH has ceiling and floor effects, a lack of both of these effects in the PRWE-J ensures the validity of both subscales of PRWE-J.

Internal consistency was assessed by use of Cronbach's α coefficient (Table 3). The α coefficients for pain, specific function, usual function, and total scores in PRWE-J (0.90/0.96/0.92/0.95) were equivalent to those of the original version (0.93/0.96/0.92/0.98),[28] the Chinese version (0.94/0.94/0.97/0.98),[18] and the German version (0.81/–/–/0.89).[29]

Instrument test–retest reliability was assessed with the ICC (Table 4). The ICCs of the pain, specific function, usual function, and total scores in PRWE-J (0.86/0.90/0.94/0.92) were equivalent to those of the original version (0.90/0.93/0.92/0.94),[28] the Chinese version (0.91/0.90/0.88/0.93),[18] and the German version (0.86/–/–/0.94).[29] This indicates that the ICCs for the PRWE-J subscales and total scale have sufficient reproducibility.

The validation process of the PRWE-J questionnaire has shown that it has validity similar to those of the Swedish version[22] and the original PRWE.[28] The strong correlations between the PRWE-J and DASH-JSSH support this validity (Table 7). The weak correlations between the PRWE-J and SF-36 failed to demonstrate this validity, although the bodily pain and physical functioning of SF-36 have moderate correlation with the German version[29] as well as the original PRWE.[28] DASH-JSSH has higher correlations with the bodily pain and physical functioning of SF-36 than PRWE-J. This is thought to be because the DASH deals with a broader region of the whole body than the PRWE. These results demonstrated that the PRWE-J measures only one area of health-related quality of life.

The pain scale of PRWE-J exhibited high unidimensionality (Table 5, Fig. 1), and there was no low item–scale correlation. The loading of this scale was very high. These results show that the pain scale of PRWE-J has a high quality of validation.

The functional scale of PRWE exhibited bidimensionality (Table 6, Fig. 2). The two factors could be clearly separated into specific function and usual function. This means that the functional scale of PRWE-J has a high quality of validation.

Cohen's rule-of-thumb for interpreting the "effect size index" (a value of 0.2 is small, 0.5 is moderate, and ≥0.8 is large) can be applied to the SRM.[26] The responsiveness (SRM/ES) of the pain scale and functional scale of the PRWE-J for the patients overall were excellent 3 months after operation and were larger than those of the DASH-JSSH. The responsiveness of the pain scale and functional scale of the PRWE-J for patients with a distal radius fracture were equivalent to the results 3 months after operation.

We believe the strengths of this study are that the PRWE-J demonstrated good reproducibility, consistency, and validity. Moreover, it had good responsiveness.

Conclusions

We concluded that the Japanese version of PRWE (PRWE-J) has evaluation capacities comparable to those of the original PRWE. We expect that use of this scale in Japan for self-assessment by patients of treatment will contribute to meaningful improvement of outcomes for patients with wrist problems.

None of the authors of this manuscript has received any type of support, benefits, or funding from any commercial party related directly or indirectly to the subject of this article.

References

1. Simmen BR, Angst F, Schwyzer HK, Herren DB, Pap G, Aeschlimann A, et al. A concept for comprehensively measuring health, function and quality of life following orthopaedic interventions of the upper extremity. Arch Orthop Trauma Surg 2009;129: 113–8.
2. Meenan RF, Gertman PM, Mason JH. Measuring health status in arthritis: the arthritis impact measurement scales. Arthritis Rheum 1980;23:146–52.
3. Meenan RF, Mason JH, Anderson JJ, Guccione AA, Kazis LE. AIMS2: the content and properties of a revised and expanded Arthritis Impact Measurement Scales Health Status Questionnaire. Arthritis Rheum 1992;35:1–10.
4. Roach KE, Budiman-Mak E, Songsiridej N, Lertratanakul Y. Development of a shoulder pain and disability index. Arthritis Care Res 1991;4:143–9.
5. Levine DW, Simmons BP, Koris MJ, Daltroy LH, Hohl GG, Fossel AH, et al. A self-administered questionnaire for the assessment

of severity of symptoms and functional status in carpal tunnel syndrome. J Bone Joint Surg Am 1993;75:1585–92.
6. Hudak PL, Amadio PC, Bombardier C, Upper Extremity Collaborative Group (UECG). Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand). Am J Ind Med 1996;29:602–8.
7. MacDermid JC. Development of a scale for patient rating of wrist pain and disability. J Hand Ther 1996;9:178–83.
8. Chung KC, Pillsbury MS, Walters MR, Hayward RA. Reliability and validity testing of the Michigan Hand Outcomes Questionnaire. J Hand Surg [Am] 1998;23:575–87.
9. Atroshi I, Johansson R, Sprinchorn A. Self-administered outcome instrument in carpal tunnel syndrome: reliability, validity and responsiveness evaluated in 102 patients. Acta Orthop Scand 1998;69:82–8.
10. Imaeda T, Uchiyama S, Toh S, Wada T, Okinaga S, Sawaizumi T, et al.Validation of the Japanese Society for Surgery of the Hand version of the carpal tunnel syndrome instrument. J Orthop Sci 2007;12:14–21.
11. Changulani M, Okonkwo U, Keswani T, Kalairajah Y. Outcome evaluation measures for wrist and hand: which one to choose? Int Orthop 2008;32:1–6.
12. MacDermid JC, Richards RS, Donner A, Bellamy N, Roth JH. Responsiveness of the Short Form-36, disability of the arm, shoulder, and hand questionnaire, patient-rating wrist evaluation, and physical impairment measurements in evaluating recovery after a distal radius fracture. J Hand Surg [Am] 2000;25:330–40.
13. Angst F, John M, Goldhahn J, Herren DB, Pap G, Aeschlimann A, et al. Comprehensive assessment of clinical outcome and quality of life after resection interposition arthroplasty of the thumb saddle joint. Arthritis Rheum 2005;53:205–13.
14. Kołodziej RK, Blacha J, Bogacz A, Mazurkiewicz T. Long-term outcome of scaphoid nonunion treated by the Matti-Russe operation. Ortop Traumatol Rehabil 2006;8:507–12.
15. De Smet L, Robijns F, Degreef I. Outcome of proximal row carpectomy. Scand J Plast Reconstr Surg Hand Surg 2006;40:302–6.
16. Johnston K, Durand D, Hildebrand KA. Chronic volar distal radioulnar joint instability: joint capsular plication to restore function. Can J Surg 2009;52:112–8.
17. Voche P, Dubert T, Laffargue C, Gosp-Server A. [Patient-rated wrist questionnaire: preliminary report on a proposed French version of a North American questionnaire designed to assess wrist pain and function.] Rev Chir Orthop Reparatrice Appar Mot. 2003;89:443–8 (in French).
18. Xu W, Seow C. Chinese version of patient rated wrist evaluation (PRWE): cross-cultural adaptation and reliability evaluation. Ann Acad Med Singapore 2003;32(suppl):S48–9.
19. Wah JW, Wang MK, Ping CL. Construct validity of the Chinese version of the Patient-rated Wrist Evaluation Questionnaire (PRWE-Hong Kong Version). J Hand Ther 2006;19:18–26.
20. John M, Angst F, Awiszus F, Pap G, Macdermid JC, Simmen BR. The patient-rated wrist evaluation (PRWE): cross-cultural adaptation into German and evaluation of its psychometric properties. Clin Exp Rheumatol 2008;26:1047–58.
21. Wilcke MT, Abbaszadegan H, Adolphson PY. Evaluation of a Swedish version of the patient-rated wrist evaluation outcome questionnaire: good responsiveness, validity, and reliability, in 99 patients recovering from a fracture of the distal radius. Scand J Plast Reconstr Surg Hand Surg 2009;43:94–101.
22. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. Spine 2000;25:3186–91.
23. Impairment Evaluation Committee of Japanese Society for Surgery of the Hand. Charts for functional evaluation of the hand. 4th edn. Nagoya: Japanese Society for Surgery of the Hand; 2006. p. 14–5 (in Japanese).
24. Imaeda T, Toh S, Nakao Y, Nishida J, Hirata H, Ijichi M, et al. Validation of the Japanese Society for Surgery of the Hand Version of the Disability of the Arm, Shoulder, and Hand (DASH-JSSH) Questionnaire. J Orthop Sci 2005;10:353–9.
25. Fukuhara S, Bito S, Green J, Hsiao A, Kurokawa K. Translation, adaptation, and validation of the SF-36 health survey for use in Japan. J Clin Epidemiol 1998;51:1037–44.
26. Liang MH, Fossel AH, Larson MG. Comparisons of five health status instruments for orthopedic evaluation. Med Care 1990; 28:632–42.
27. Kazis LE, Anderson JJ, Meenan RF. Effect sizes for interpreting changes in health status. Med Care 1989;27(suppl):S178–89.
28. MacDermid JC, Turgeon T, Richards RS, Beadle M, Roth JH. Patient rating of wrist pain and disability: a reliable and valid measurement tool. J Orthop Trauma 1998;12:577–86.
29. Hemelaers L, Angst F, Drerup S, Simmen BR, Wood-Dauphinee S. Reliability and validity of the German version of "the Patient-Rated Wrist Evaluation (PRWE)" as an outcome measure of wrist pain and disability in patients with acute distal radius fractures. J Hand Ther 2008;21:366–76.